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# GIS Thematic Mapping as an Instrument of Analysis for the Identification of the Rural in Complex Territories

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The content of this work is based on the doctoral research about rural territories within São Paulo urbanization in a macro-metropolitan context. The objectives of this lecture is to show the differences between the Brazilian official territorial classification of rural and urban spaces and the reality found in these areas based on an exploration of the concept of rural and the variables that characterize it.

In addition to this it will be demonstrated the relevance of Geographic Information System (GIS) tools and the creation of thematic cartography as an important instrument of theorization. In order to achieve these objectives the presentation will treat:

- 1.The context of the “Macro-Metropole Paulista (MMP)” in Sao Paulo State;
- 2.The Brazilian Institute of Geography and Statistics (IBGE) classification and the MMP urbanization - Spatialization as an analytical tool;
- 3.Characteristics of MMP municipalities - 3 examples;
- 4.The differences between IBGE classification and what is seen in the territory - 3 municipalities: Joanopolis, Piracaia and Sao Paulo;
- 5.Urban and rural concepts and approaches;
- 6.Possible contributions for comparative analysis.

## The context of the Macro-Metropole Paulista (MMP) in State of São Paulo

About the context of the Macro-Metropole Paulista (MMP) in the State of São Paulo, in terms of

respective municipalities and regions within the boundaries there, includes four others metropolitan regions: Campinas, Baixada Santista, Sorocaba, and Vale do Paraíba e Litoral Norte; two urban agglomerations, Jundiai and Piracicaba; and one regional unit named Bragantina.

This territory is composed of 174 municipalities and a population of around 31 million people that corresponds to 75% of the State of São Paulo; its area is around 53.000 Km<sup>2</sup>.

The map below (Fig.1) comes closer to this territory where the MMP is situated and shows its urban spots. It is possible to observe that the urbanization is mainly concentrated around São Paulo municipality to the others that surround it through the main routes. This occupation alternates dense populated areas located along the axes and the areas of dispersed settlements as the municipalities are further away from larger agglomerations.

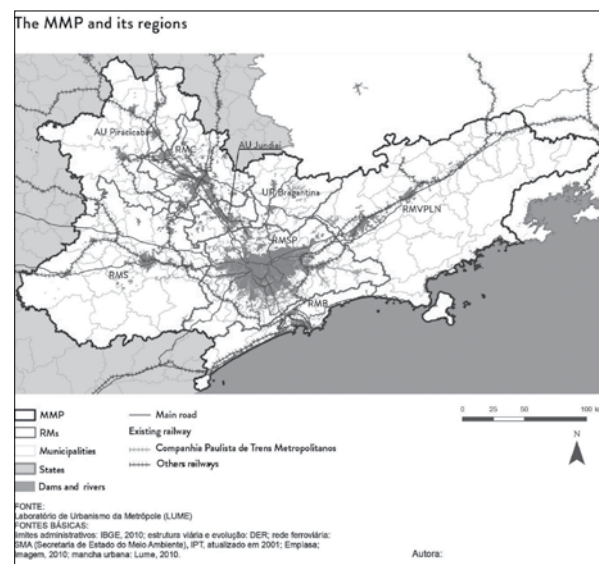


Fig.1 The MMP and its regions

In Brazil since the end of the 1960s, industries were stimulated to move out of São Paulo city and be located on both the interior of State of São Paulo and the rest of the country, specially the north-east and the middle-east of the country. The process of

urbanization thus accelerated during the 1960s and in the 1970s (Fig.2) when the country became effectively urban.

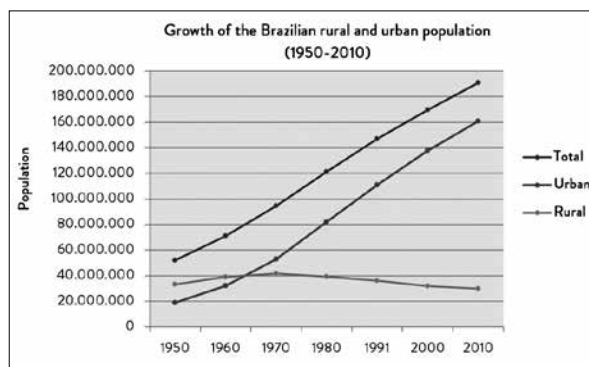


Fig.2 Brazilian urban and rural population

The definition of Rural and Urban spaces is too complex and involves many different points of views depending on economic, social and cultural contexts, and also politic and institutional concerns. In Brazil the urban and rural limits are defined by the municipalities following a simple definition based on the 1938 Law and there lacks a well-developed national criteria for this. The varied definitions in use involve many local private and public interests.

Most of the authors consider the relevance of agriculture and livestock activities other than the population density for the definition of the predominance of natural landscapes. However, during the last decades transformations brought mainly by both transportation and communication technology have deeply changed rural and urban areas. In this sense, rural and urban spaces can no longer be defined only on bases of the old, or traditionally used parameters in order to characterize these spaces.

### Three examples of MMP municipalities and the differences between IBGE classification and what is seen in the territory: Joanópolis, Piracaia, and São Paulo.

Through the use of GIS and the spatialization of data of what the IBGE consider as urban and rural, overlapped by the urban spot in the MMP region it can be seen below that they don't match each other. The follow maps show first the IBGE rural and urban (red) areas; second, the urban spot that was produced by the satellites images; and third, the overlapped images (in light colors the urban spot and in red the urbanization according to IBGE classification). The fourth map expresses in detail the discrepancies between these datasets. The following represents three cases of these discrepancies. (Fig.3)

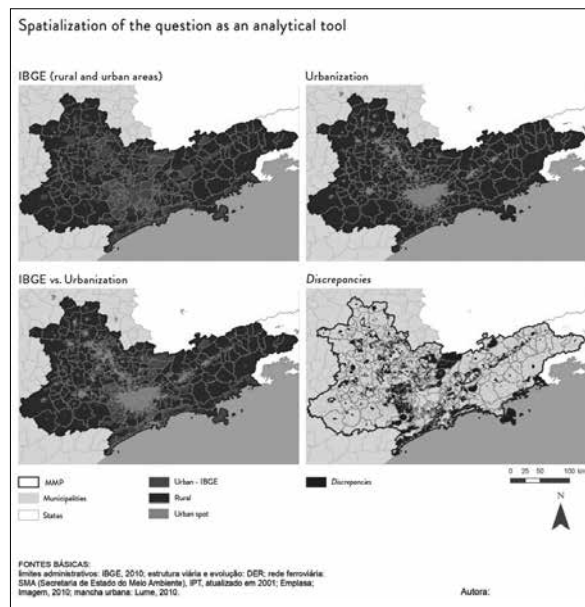


Fig.3 Spatialization of the question as an analytical tool

Joanópolis, Piracaia and São Paulo municipality show different types of discrepancies. At first, in São Paulo's case except for the legally protected areas, 100% of its territory is covered by urban spots (Fig.4). Despite this, not the totality of its population is considered urban by IBGE (99%). In this case, we see more similarities between the data although there are still small differences (in red what is out of urbanization). Another case, Joanópolis and Piracaia, shows completely different limits between the IBGE classification and the urban spots.

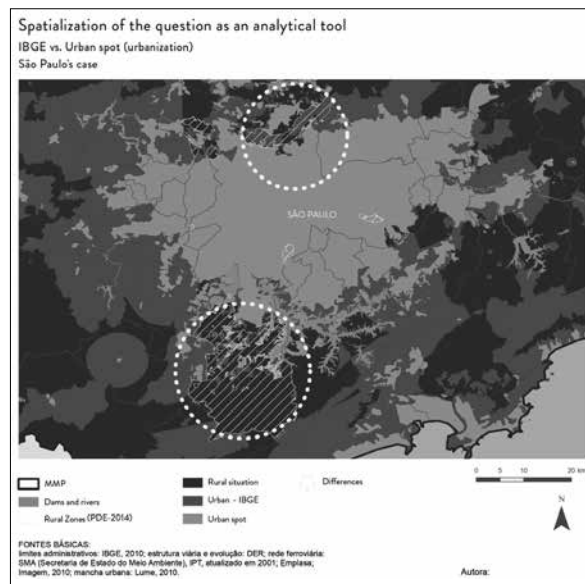


Fig.4 Spatialization of the question for São Paulo's case IBGE x urban spot (urbanization)

Detailing the examples, the data from these municipalities shows that Joanópolis and Piracaia (Fig.5) have low density and higher percentage of agriculture employment. However, according to the

IBGE there is no rural population and both municipalities totality population are considered “urban”. Some data related to the agriculture and livestock activities, show no agricultural areas and agricultural areas with sharing different type of activities compared to those ones seen in the past. Agriculture and livestock areas are predominant in Joanópolis and Piracaia according to our results not necessarily with an intensive production but also with activities associated to tourism, leisure, and services.

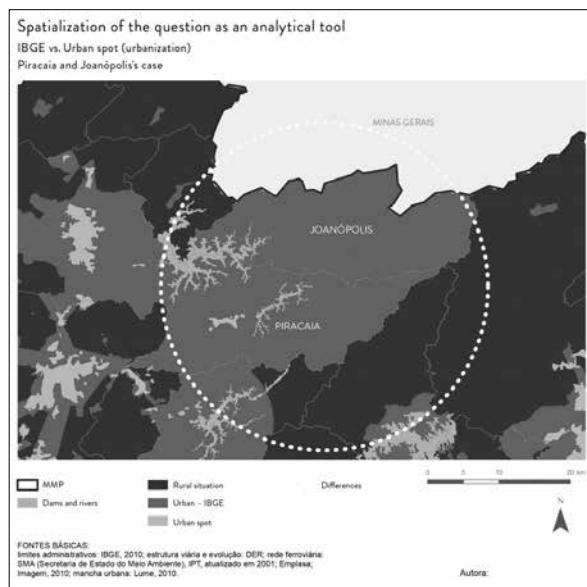


Fig.5 Spatialization of the question. Piracaia and Joanópolis' case

On the other side São Paulo that is considered to have no agricultural areas, includes still some rural population according to the IBGE.

With more specialized maps is possible to clearly observe these discrepancies. In Joanópolis because there is no urban spot in the index and in Piracaia the urban spot is too small considering the size of the municipality and the classification of IBGE as “urban”. These two municipalities are then defined as completely “urban” according to IBGE. In São Paulo's case there is in the north, the Serra da Cantareira that is a conservation area protected by law which is classified by the IBGE as “urban”.

### Urban and rural concepts and approaches

In metropolitan areas or the territories that had become increasingly complex rural and urban areas definition are blurred by the presence of new functions that coexist with old functions which can no longer be located in traditional spaces. In these complex territories it is necessary to incorporate a larger number of variables into the analysis in order

to identify the rural and the urban in different contexts, with different data sources, different territorial boundaries and scales, varied data temporality and qualitative variables. Thus, it becomes necessary to consider this variability and the relationship between the various data. It becomes necessary to survey specific variables and parameters in an attempt to identify the rural and the urban, taking in to account the new territorial configurations of the context specifically in the case of MMP and in many other cases including different countries.

The use of a geodatabase (ArcGIS) modeled to meet search requirement aid in the elaboration of the cartography to support the analysis. As a result these tools can be shared in order to deepen the analyses helping to add and updating data to the general database and easily to spread the knowledge.

We are working with some special topics in this research related to the variables that requires an analyze over time; other variables population, spot density, employment, income, households and so on; the attention must be called up for the ones that can revel specificities to be modeled in database.

### Possible contributions for comparative analysis

Our aim today is to show that this is a tentative to work with a large number of variables by integrating the variables that already exist in a work done during the past 4 years. In the future we plan to integrate these variables with the support of the software called SOM (Self-Organizing Map): a type of Artificial Neural Network Center that is able to deal with complex analysis in order to classify the territory as urban to the rural areas. This kind of tool would allow for the combination and analysis of a great number of attributes (which can be treated in binary relations like yes/no; have/do not have). The variables can be treated as low, medium or high, and also can be considered as quantitative values or percentages allowing the combination of different data scales from municipal scales to the Census definitions and so on.

I plan initiate an attempt towards this direction in cooperation with Professor Clayton Carneiro and Professor Mariana Giannotti (both from Poli/USP): from the rural to the urban and through the peri-urban and not using a dichotomy between rural and urban areas.

Although some difficulties exist, it would be possible to put together some countries in the same



research. However, this scheme about Brazil already demonstrates the challenges ahead. The analysis of only one country like Brazil demands the integration of many pieces of data and a lot of times would be needed if we try to do this with other regions inside the country, including federal unities and municipalities and sub-prefectures. It is worth to emphasize that in Brazil some boundaries are not national but located at federal unities' limits. It would be necessary then to discuss about a large set of variables and definitions if we consider the possibility to work with the comparison of different countries. If in Brazil it is already difficult to have unified definitions between the federal unities, a workable definition that can be used with other countries is even more difficult. The comparison might not be direct but I think that to counter different cases in order to see each ones specificities can produce good results in the future.

For the purpose of engaging in such a type of comparison it would necessary to consider similarities and divergences between entities and boundaries, infrastructure, environmental laws, as much as, demographical, social and economic data and others, as well as relationships and attributes of the database model.

### Questions and Comments

**(Luis SAN PABLO)** You have shown us the population growth of Brazil from the 1960s until now. It is impressive to see how this population is growing from about 60 millions to almost 200 millions. Do you think that this the rate of population growth in the future be the same or might reduce in the future?

**(Roberta FONTAN)** Do you mean this diagram which shows the population numbers in urban and rural areas?

**(Luis SAN PABLO)** Yes that one. Rural areas' population remain more or unchanged, but the urban population grows spectacularly. Do you think that the rhythm of fast growth will continue in the future?

**(Roberta FONTAN)** The prospective data from IBGE consider that the growth rate will probably slows down in the next 20 years. Actually, the growth will continue to occur but the location of growth tends being dispersed through the territory. It means that it will not be as concentrated as seen in the past.

**(Sacko OUSSOUBY)** In African cities there are a lot of spontaneous growth just around the borders of urban areas, because your transition analysis focuses on urban-rural movements, but there exist a lot of layered spaces and varied growth within layered spaces, thus whenever the movement occurs in borderline territories it is difficult to decide if the growth is occurring in urban areas or in rural areas. In African cities, it becomes forcefully necessary to revise urban boundaries because the urban limit definitions do not follow the spontaneous movement of people. For example, I saw among your variables that you use land registration data. However, in the case of African cities large areas are not registered. Is it possible to include in GIS cartography some kind fuzzy condition which could represent this kind of movement? Within the layers of growth how to choose where to include them in between urban and rural "spontaneous" boundaries pushing?

**(Roberta FONTAN)** We have some GIS resources that can be useful to represent informality. But informality may occur in both rural and urban areas. If an informal occupation exists, there are mechanisms to change the law or municipal decision ignorer to incorporate these areas as rural or urban. But usually the definition of the population as urban or rural depends on the counting of the population in the location that they are fixed. This real geographical location is expressed in maps with official definitions of land-use. The limits and informalities over are defined in dependence of regulator authorities it mostly goes to rural incorporation.

**(Sacko OUSSOUBY)** I say this because many definitions tend to be applied to every world city although they do not fit the reality of many African cities.

**(Roberta FONTAN)** I find this kind of discussion sits in the core of this debate. When I take into consideration certain variables I know that I have to define it according to the specificity of my case study. For example, when we take into consideration the density of settlements, a number like 150 could inform a low density in Brazil but perhaps not in another country. Thus, when defining that 150 is characteristic of an urban area or a rural area, I have to take into consideration the specificities of every place. That is why I hope that using neural networks system, the SOM (Self organizing map), I will be able to adjust the analysis to specific region-

al definitions. Thus, I could input the information of what is a high or low density according to regions, and the system would represent rural and urban areas according to the varied definitions of what is low or high in varied contexts. With this I hope to be to create a gradient between rural and urban. I believe from this I could interfere in the analysis by adjusting the variables according to the answers I receive.

**(Sacko OUSSOUBY)** I talk about this because the Harvard University is developing a world map following almost the same idea. They are trying to put emphasis in what is rural and what is urban; they have also the analysis of poverty degree so the GIS developing map should contain several world cities, and try to globalize the analysis with different cultures and regions. I think that maybe working more with variables that aim to extend the GIS map or this software you should try to include variables which can take in account some situations that can be much more fuzzy between urban and rural

**(Hugo SEGAWA)** I think you are putting a question mark on the dual category of urban and rural. From planning perspectives or from the planning practice, do you think that we need to operate in subcategories or should we find new modalities or new ways to understand this transition between urban and rural? How could a planner consider this unclear border between urban and rural?

**(Roberta FONTAN)** I don't know if I should say this, what I will say now, but, maybe we can think about the possibility of consider not to divide, or to classify, the land into rural and urban areas. My preoccupation is that several of the researches in Brazil and the people that use this data considered that Piracaia and Joanópolis, for example, are urban areas, which is not true. So maybe this dichotomy is not really relevant. The people living there, they are inhabitants of Piracaia and Joanópolis simply. The urban and rural activities in the MMP context now are so integrated that nowadays the São Paulo municipality, which has no rural areas, will start to delimit some specific areas as rural and introducing and stimulating the development of rural activities by their population. Also many people in rural areas who used to work in agriculture are changing for service activities connected to tourism, leisure, for example. Maybe the question is not if they are rural or urban but their needs to have a good life and to be productive people. If they have the necessary conditions to carry on with their own lives.